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Mistletoes on Hardwoods in the United States

Katy M. Mallams[1] and Robert L. Mathiasen[2]

Most people in North America know of mistletoes because of the Christmas-related traditions that surround these parasitic flowering plants. Some may also realize that mistletoes parasitize trees and can damage or kill their hosts. However, many are not aware that these parasitic plants are also ecologically important components of many forests around the world.

Figure 1. Phoradendron villosum on Oregon white oak.

In the western hemisphere, mistletoes in the genus *Phoradendron* are parasites of both coniferous and hardwood trees and shrubs. They are most common in the tropics but there are several that occur in temperate and desert regions of the United States. They are generally intolerant of cold weather and their northern distribution is probably limited by cold winter temperatures. This leaflet focuses on the species of *Phoradendron* that affect hardwoods. They are sometimes referred to as the "true mistletoes" or "leafy mistletoes" and are the mistletoes that people often collect for decoration at Christmas.

Phoradendron species that parasitize conifers are discussed in FIDL #164 (Hawksworth and Scharpf 1981). Conifers are also parasitized by dwarf mistletoes in the genus *Arceuthobium*. Another species of mistletoe, *Viscum album*, the European mistletoe, was introduced in Santa Rosa, California in 1900 by Luther Burbank, the famous horticulturist. It infects a wide range of hardwood trees and shrubs, but is found only in the vicinity of the area where it was originally introduced.

[1]*Plant Pathologist, USDA Forest Service, Pacific Northwest Region, Central Point, OR.*
[2]*Professor, School of Forestry, Northern Arizona University, Flagstaff, AZ.*

Identification

Mistletoes in the genus *Phoradendron* typically form round to oblong clumps of leafy, evergreen foliage that emerge from the branches or trunk of the host (Figure 1). There is often a slight swelling where the mistletoe shoots emerge (Figure 2). In older trees, these swellings may become quite large and broken open, exposing decayed wood. Mistletoe infection in deciduous trees is easiest to observe in winter when the trees are leafless.

Figure 2. Phoradendron villosum *shoots emerging from slightly swollen branch on Oregon white oak.*

In the western United States, there are five species of *Phoradendron* affecting hardwoods, found mostly in the Southwest and California. One species, *Phoradendron villosum*, occurs as far north as northern Oregon. Only two species of *Phoradendron* occur in the eastern United States: *Phoradendron rubrum*, affecting mahogany in southern Florida, and *Phoradendron serotinum*, which affects over one hundred different species of hardwoods from New Jersey south to Florida and west to Louisiana, Arkansas, Missouri, and then through southern Illinois, Indiana, Ohio and much of West Virginia. The latter species is also found in Virginia, the Carolinas, Kentucky, and Tennessee. In general, the mistletoe species on hardwoods in the United States are best identified by their geographic location (Figures 3 and 4) and host species (Table 1). Characteristics of the plants, leaves, and fruits can also be used to assist with their identification.

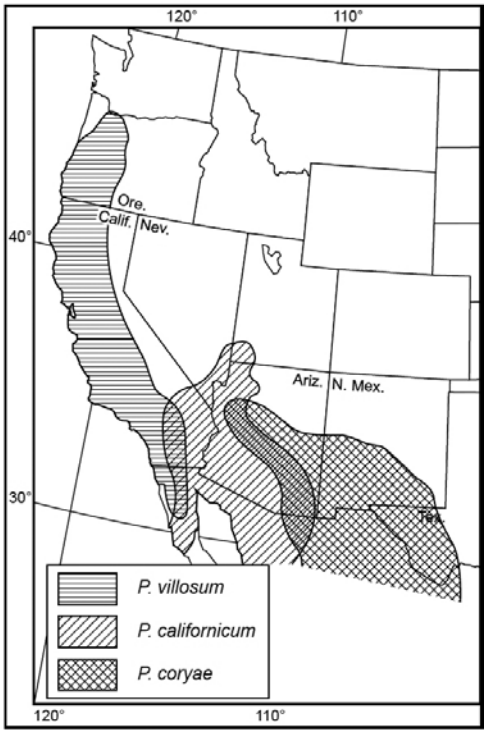

Figure 3. Geographic distribution of Phoradendron villosum, Phoradendron californicum, *and* Phoradendron coryae.

Biology

Members of the genus *Phoradendron* are green, flowering plants, but they are parasites and require a living host from which to obtain water and minerals. Although they are capable of photosynthesis and produce much of their required carbohydrates, they may also acquire some of their

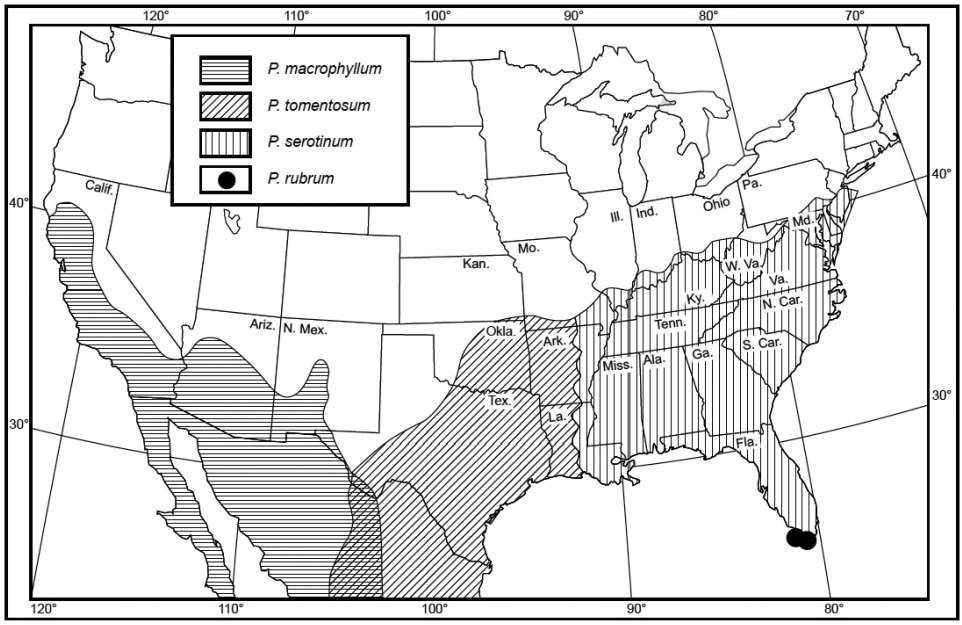

Figure 4. Geographic distribution of Phoradendron macrophyllum, Phoradendron tomentosum, Phoradendron serotinum*, and* Phoradendron rubrum.

Table 1. Mistletoes affecting hardwoods in the United States.

Mistletoe	Hosts and Distribution	Remarks
Phoradendron serotinum	Affects more than 100 species in 50 genera of native and introduced trees. Occurs in the eastern United States.	Extends as far west as LA and AR, possibly central and south TX. Its distribution has not been precisely determined.
Phoradendron rubrum	Affects mahogany in the Florida Keys.	Primarily occurs on Caribbean islands southeast of Florida.
Phoradendron californicum	Affects trees in the pea family, mainly mesquite, palo verde, and acacia in AZ, southern CA, and southern NV.	Leaves are small and scale-like, stems are reddish to brown, and berries are pink to reddish.
Phoradendron tomentosum	Affects hackberry and mesquite, infrequently affects oak and elm; primarily in TX and OK.	Morphologically similar to *P. serotinum,* except mature leaves are slightly hairy; mature leaves are smaller than *P. macrophyllum.*
Phoradendron macrophyllum	Affects more than 70 species in over 30 genera of native trees. Common hosts include willow, poplar, maple, ash, walnut, alder, and sycamore; not found on oaks. Occurs from central CA through AZ into central NM and south along the Rio Grande River into west TX.	Mature leaves are large (>28 mm long and 18 mm wide). Leaves are much larger and smoother than *P. villosum.*
Phoradendron villosum	Primarily on oaks, but occasionally affects other trees such as alder, aspen, buckeye, European birch, locust, manzanita, sycamore, walnut, and willow. Southern CA into northern OR.	Mature leaves are thick and hairy, smaller than those of *P. tomentosum,* and variable in size and shape.
Phoradendron coryae	Only on oaks from western TX to northwestern AZ.	Leaves are similar to *P. villosum,* but yellow-green instead of dark green. Extremely hairy leaves and stems.

carbohydrates from their host trees. If the aerial shoots of the mistletoe are removed, the root-like structure within the host branch can remain alive for many years.

These mistletoes are dioecious; there are separate male and female plants. Female plants produce inconspicuous small flowers on spikes. After they are pollinated, the female plants develop fruits called berries which are white, pink, or reddish depending on the species (Figure 5). Male plants also produce inconspicuous flowers on spikes which produce pollen that is transferred to the female flowers for pollination by a variety of insects. The male and female flowers are so similar that it is usually difficult to determine the sex of a plant unless the fruits are present on female plants.

Many mistletoes, including *Phoradendron* species, are spread by birds that feed on the mature berries. The berries are round and about one-quarter inch in diameter. A berry usually contains a single, hard seed surrounded by a sticky pulp called viscin. Birds eat and digest the pulp around the seeds and then excrete the seeds which can survive passage through the bird's gut. By this means, seeds are often deposited on susceptible hosts, spreading the mistletoe within infected trees or to nearby uninfected hosts. A viscous coating and hair-like threads on the seeds allow them to attach firmly to the host branch. Upon germinating, the growing radicle becomes tightly pressed to the branch surface. Infection takes place by means of a specialized structure that mechanically forces its way through the bark into living host tissue.

The root-like system of the mistletoe grows within the host tissue and establishes connections to the water conducting tissue (xylem). The aerial shoots develop shortly after the root-like system has become well established. Usually, several years are required following infection for the shoots to mature and produce flowers.

Mistletoes on hardwoods do not spread rapidly but once a plant is established, the root-like system slowly extends up and down the

Figure 5. Shoots and mature fruits of Phoradendron macrophyllum.

branch. Defoliation or destruction of the aerial shoots does not kill the mistletoe. New shoots may be produced from the root-like system, or the mistletoe may survive and grow within the infected branch for many years without producing aerial shoots. Not until the host tree dies or the infected branch dies or is removed will the mistletoe die.

Impacts

Young or small trees are seldom infected by mistletoe. In most cases, initial infections occur on large or old trees, particularly those growing in the open, because birds often prefer to perch in the tops of these trees, where they excrete the mistletoe seeds. Severe buildup of mistletoe often occurs within infected trees (Figure 6) because birds are attracted to and may spend prolonged periods feeding on the mistletoe berries, roosting and excreting the seeds.

In many cases, mistletoe infections on hardwoods do not cause significant damage in areas where water stress is not an issue. However, in some situations, trees severely infected with mistletoes may be weakened and may have greatly reduced growth rates. Weakened trees may be attacked by insects and often die during droughts. Furthermore, the ends of infected branches beyond the mistletoe infections often die during droughts resulting in extensive branch dieback throughout the crowns of infected trees.

Branch and trunk swellings or round galls often result from mistletoe infection (Figure 7). These swellings can become entry points for fungi that decay and subsequently weaken the wood, resulting in breakage and

Figure 6. Stand of Oregon white oak severely infected by Phoradendron villosum.

reduced commercial value. Branches with large or numerous mistletoe infections may break from the weight of the mistletoe plants. Broken branches may damage buildings, electrical lines, or parked vehicles, and injure people, particularly during wind or ice storms. In some regions, mistletoes damage crops by reducing production of fruits or nuts, such as in pecans in the Southwest and walnuts in the Central Valley of California.

Ecologic and Economic Importance

Mistletoes have ecologic, economic, and social values. Because mistletoes usually occur high in canopies of trees, they may have evolved intricate relationships with birds that serve as the principal dispersal agents of mistletoe seeds. Berries are a favored food of several bird species, including robins, bluebirds, thrushes, cedar waxwings, Townsend's solitaires, and phainopeplas, especially during the winter when other food sources are scarce. Birds will frequently defend mistletoe plants to prevent other birds from eating the nutritious berries.

The decayed wood in swollen branches and trunks provides important habitat for cavity-nesting birds and mammals (Figure 8). Primary cavity-nesting species such as flickers excavate holes in the softened wood that are later used by many other wildlife species including squirrels, bluebirds, wrens, nuthatches and small cavity-nesting owls.

Figure 7. Swollen trunk on Oregon white oak resulting from infection by Phoradendron villosum.

Deer, elk and even livestock are known to supplement their winter diet with low-hanging mistletoe plants. In some areas, livestock are fed mistletoe shoots as forage; although in other areas, the shoots and berries may not be suitable for livestock because the leaves and berries of many mistletoes contain toxic compounds.

Mistletoe has been associated with Christmas for many years, and the harvesting and sale of mistletoe plants for Christmas decorations provides seasonal income to service organizations and others that harvest large amounts of mistletoe. Due to the toxic compounds in the leaves and berries of

Figure 8. Hole excavated in decayed wood associated with Phoradendron villosum *trunk infection and swelling in Oregon white oak.*

six inches below the point of mistletoe attachment. Large branches or main stems with mistletoe infections should only be pruned if their removal will not detract from the appearance of a tree or remove a large amount of a tree's foliage. Such drastic pruning for mistletoe control may be more damaging to a tree than the mistletoe infections themselves.

some species, decorations containing mistletoe should not be eaten or left within reach of pets or young children. Although rare, cases of mistletoe poisoning have been reported in the United States.

Management

Management of mistletoes may be needed to reduce the level of infection or prevent severe infections from developing. Valuable trees near private homes, businesses, in recreation areas, or in commercial orchards can be treated to minimize the effects of mistletoe infections, reduce the number of infections, or even eliminate mistletoe when trees are only lightly infected. This can be accomplished by pruning infected branches, removing mistletoe shoots, or applying selective chemical treatments.

Pruning: Pruning is practical when a tree does not have many mistletoe infections and they are not on primary stems or large branches near the main bole. Branches with mistletoe infections should be pruned at least

The number of mistletoe-infected branches that should be pruned will vary from tree to tree depending on a number of considerations, but removing even a few infected branches can increase the overall health of a tree by reducing the water stress associated with mistletoe infection. Keep in mind that birds may re-introduce mistletoe into pruned trees, and mistletoe plants that were small and difficult to observe when the tree was initially treated may become apparent, necessitating periodic retreatment.

It is generally recommended that trees be inspected every three to five years so new infections can be pruned as they occur. This will prevent the level of infection from becoming severe and potentially damaging. Detection of mistletoe infections is most easily accomplished during the winter on hardwood trees because the mistletoes are evergreen and can be observed when the leaves of the trees have fallen off. Mistletoe plants attached to pruned branches cannot cause new infections, so they do not need to be destroyed.

Removal of Aerial Shoots: Simply removing aerial shoots of mistletoe from tree branches can also reduce the water stress placed on trees. Removing the mistletoe shoots does not kill the portion of the mistletoe plant inside the branch so eventually it will sprout new shoots that will need to be removed. Trees should be inspected every three to five years to find and remove new shoots. Removing mistletoe shoots may be impractical when trees have many infections because of the labor involved, but it can be combined with pruning infected branches. Small branches with mistletoe infections can be pruned, and mistletoe shoots can be removed from large branches and main stems. Combining these treatments may prolong the life of severely infected trees.

Another method of mistletoe management that has been attempted but has not proven effective or aesthetically acceptable is removing mistletoe shoots from infected branches or trunks and wrapping the infected area in black plastic or tar paper. It was thought that this would prevent light from reaching the infected part of the branch, thereby preventing or slowing the emergence of new mistletoe shoots. Some arborists still recommend this practice but it has not been effective in most cases.

Chemical Treatments: Several chemical treatments have been tested for mistletoes affecting hardwoods in the United States but many of these have not proven effective in killing the mistletoe or they have caused unacceptable damage to the host trees. One chemical that has been tested and proven effective is a growth-regulating compound, ethephon (trade name Florel ™). Mistletoe shoots are sprayed with ethephon to the point of saturation. In one to three weeks, the mistletoe plants drop off. However, the portion of the mistletoe plant within the tree branch is not affected so new mistletoe shoots will emerge in one to three years. In many cases, this treatment may provide an acceptable level of control. As it is relatively more expensive than hand pruning, the cost of application of ethephon should always be considered before initiating treatment.

In the Southwest and California, pecans and walnuts infected with *Phoradendron macrophyllum* are treated with herbicides during the winter when the host trees are dormant. Because the mistletoe is an evergreen and still physiologically active during winter, the mistletoe is killed when it absorbs the herbicide. The host trees are dormant so they are not adversely affected.

A technique that has been applied in India on mangoes infected by mistletoes is to wrap bands saturated with herbicide around the base of mistletoe plants that have been scored with a knife to expose the water conducting elements in the mistletoe shoots. This method has proven effective in killing the mistletoe without harming the host trees but it has not been tested in the United States. Because of the labor required to wrap the bands around each mistletoe plant, it may prove impractical here.

Planting Mistletoe-resistant Trees: When trees have many mistletoe infections throughout their crowns and/or on their main stems, it may be necessary to remove the tree and plant another in its place. Planting trees that are not susceptible to mistletoes that occur in the area is the most effective way to prevent infection and is probably the best means of preventing mistletoes from becoming established around homes and businesses in urban areas. Therefore, correct identification of the local mistletoes and their host species is critical. Tree species selected to replace mistletoe-infected trees should be those that are suited to the location and climatic conditions in the area. Arborists, nursery personnel, and county extension agents can provide recommendations regarding which tree species are appropriate to plant.

In wildland forests, mistletoe reduction can be accomplished by harvesting infected trees, and retaining and planting non-host species. Pruning is only practical for high-value trees in recreation areas, around homes and businesses, or in orchards where the crop is commercially valuable. Removal of infected branches by pruning or removal of the plants will not insure that trees will not be infected again. Because birds are the principal dispersal agents of these mistletoes, they are likely to re-introduce mistletoe onto previously treated trees.

Assistance

Private landowners can get more information from County Extension Agents, State Forestry Departments, or State Agriculture Departments. Federal resource managers should contact USFS Forest Health Protection (www.fs.fed.us/foresthealth/). This publication and other Forest Insect and Disease Leaflets can be found at www.fs.fed.us/r6/nr/fid/wo-fidls/.

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